QuickCareRecord: Efficient Care Recording Application with Location-based Automatic View Transition and Information Complement

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Abstract—In Japan, the demand for nursing home is increasing due to the increase in the number of elderly people. However, the work burden for nursing staffs is very large. Specially, they spend much time in making care reports which reduces the time for doing the essential care for residents in a nursing home. Therefore, to reduce the load for staffs, the system on which staffs can create reports easily and instantly is needed. In this paper, we propose a mobile memo system that switches the view according to the location automatically and assists inputting the necessary information. Our proposed system enables care staffs to prepare the care report about caring for the elderly person quickly. Through the evaluation in the emulated environment, we show that our system succeed to reduce the time for recording by 37.9% and 58.9%, compared with the conventional system and traditional handwriting, respectively.

Index Terms—Nursing Care, Mobile Application, BLE Beacon

I. INTRODUCTION

In recent years, the demand for nursing care services has been increasing along with the increasing number of the aging population in Japan. However, due to the increased workload and lack of nursing care staff, the quality of nursing care services is declining and it has become a problem. According to the survey of nursing care homes in 2016 [1], 62.6% of the nursing homes answered that they are suffering from the lack of nursing staff. Hence, one nursing staff has to do the nursing for several residents simultaneously, which intensifies the work load.

Among various kinds of work of the nursing staff, writing daily care report is the most important one. Daily care report is a record that includes the information of the status and activities of the residents. Fig. 1 shows the typical care report format used in Japan. It mainly consists of two parts. The left side is indicates the time of completion of activities such as toilet, meal, rehabilitation, etc. The right side is a column for writing detailed care records such as vital data, meal contents, contents of rehabilitation etc. The daily care report is usually used to improve the nursing service and share the information with other nursing staffs, the resident or the family of the resident. Although writing daily care report is very important, it has become a heavy load to the nursing staffs. Miwa et al. [2] reported that about 25% of the work time is consumed in writing care reports.

Fig. 1. Example of care report.

Therefore, we have started research on the semiautomatic generation of nursing care reports by collaborating with actual nursing home. Our previous work [3]–[6] focused only on filling the left side of the care report (Fig. 1) and proposed the system consisting of BLE beacons attached to residents and beacon scanners deployed in the facility. By observing the variation of RSSI, the system recognizes and records the location of residences with time stamp. In this paper, we focus on the right side of the care report where the detailed care contents are recorded.

In a nursing home, there is a strong correlation between the nursing care location and nursing care content. In order to record items depending on nursing care contents, we need to achieve two important points. First, the system should be able to detect and specify the care recipient and the nursing care place instantaneously. Second, the nursing staff should be able to easily record the nursing care content depending on the nursing care place. Currently, most of the nursing homes attach sticky notes in each location of the home, and nursing staffs write nursing care content on the sticky note every time they do

the nursing. However, in this method, staffs must collect and classify these sticky notes for each resident, then summarize them as nursing reports, which is a heavy load to the staffs.

Many applications for recording care contents have been released in the market. However, since these applications have many contents to input, it takes many steps before the staff completes them all. Also, they assume to be used in the nursing office. Therefore, the nursing staff still have to spend long time for making the care record every evening.

To solve the problem in recording the care report, we propose a novel mobile application with view switching function and information complementing function according to the location. In our system, the mobile devices (we use iPod touch) that nursing staffs carry with specify both the nursing care location and nursing care recipient by observing the Bluetooth Low Energy (BLE) signal from the BLE beacons attached to the residents and each location of a nursing home.

After specifying the location and recipient, the application automatically switches its view to specify care activities related to location. Then, the staff taps the items in the view of the application to input the information and send it to the server when they finish inputting. For example, when a staff is nursing a resident in the toilet, the system specifies the toilet as the nursing care place and the resident as the care recipient, and shows the record items related to the toilet and the resident (e.g., the situation of the feces and the pee).

To evaluate the performance and effectiveness of our proposed system, we conducted an evaluation experiment in our laboratory. In the experiment, we compared the time for inputting information, the accuracy of recording and the usability of the system between the proposed system, the conventional system and the handwriting method. The result shows that by using the proposed system, the time for inputting information is shortened while maintaining the accuracy of recording. Moreover, we found that participants can easily understand how to use the system. The participants also reported that they felt less annoyed when they used the proposed system to make care reports.

The rest of this paper is organized as follows. Section II reviews existing work related to this paper. Section III presents our proposed system. Section IV describes experiments and results. Finally, Section V concludes this paper.

II. RELATED WORK

In the nursing home, staffs have to do the nursing for several residents simultaneously and make care report for each resident. The load of making records is heavy for staffs. According to the research [2], approximately 25% of their daily work is recording work. Also, the research [7] reported that writing report is one of the most time-consuming tasks. As shown in these research, staff have lesser time for essential nursing works due to report writing. Therefore, many studies have focused to reduce the load of making reports.

There is a study that supports making care reports by collecting voice message from staffs in cooperation with smart phone and head-set, and share the information with other staffs

[8]. However, this system cannot make care reports directly but only show or share the information. Staffs have to make care reports by checking the information.

For home nurses, there is a system with which nurses can input information about the patient by using smart phone [9]. Nurses record the message or nursing contents by using their voice, and they share the voice message. However, in this system, they must record voice message and listen to them, which it is also troublesome.

Some studies [10], [11] used ECG sensors, heart rate sensors and temperature sensors for physiological monitoring, and accelerometer sensors attached to the human arm to estimate patients movements. However, they can only collect information roughly, instead of the detailed contents about nursing. Through the camera attached to the resident, staff can know the location of residents [12]. However, this method has privacy problem.

In addition, we conducted a research to estimate activities of residents by using BLE beacons, and to generate semi-automatic daily care reports by summarizing information in time series [3]. In this system, we observed the RSSI value of the BLE signal emitted from the BLE beacon carried by each resident through receiver, and semi-automatically generate care reports by estimating the location of residents and activities by machine learning. But this system was still unable to record detailed contents.

III. PROPOSED SYSTEM

To offset the limitations in our previous system, we propose a novel mobile memo system. In this section, we introduce the configuration of the proposed system and the design of application.

A. System Configuration

Daily care reports usually contain specific information related to the location, for example, the situation of the feces in the toilet, the information of meals in canteen, etc. In this study, we propose a mobile memo system which can automatically switch information input screen and its items depending on location. The mobile memo system can identify the nursing staff and the recipient automatically so that the staff can easily create the daily care report. To realize this system, it is necessary to achieve the following three requirements:

- Switch the view automatically depending on the location in the nursing home
- Identify the elderly or nursing staff and show the result on the screen
- Provide comprehensible interface and usage

B. System Design

The configuration of the system is shown in Fig. 2. The system consists of BLE beacons attached to residents for identifying the care recipient, BLE beacons attached to each location of the nursing home for identifying location of the nursing, the devices installing the memo system for inputting
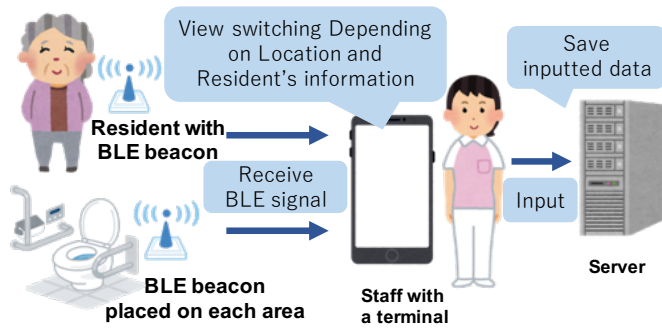
Fig. 2. System flow

Fig. 3. Application.

information, and a cloud server for storing data and dealing with information transmission (e.g. identification of residents, daily care reports, etc.).

The residents of the nursing home are required to carry a BLE beacon with them while staying inside the nursing home. Each BLE beacon has unique Universally Unique Identifier (UUID), major, minor numbers so that each resident can be identified by these numbers in this system. Typically, when a staff does some care activities, the care recipient is usually the resident closest to the staff. Therefore, the device carried by the staff scans the Bluetooth signal emitted from the BLE beacons (attached to residents) and calculates the Received Signal Strength Indication (RSSI) value. After calculating the RSSI value, the device picks the origin (resident) of the strongest signal as the recipient and shows it on the screen.

We also install BLE beacons in each location of the nursing home so the device can identify the location of the staff in the same way as the identification of the recipient. Each BLE beacon has UUID, major, minor, numbers so that each resident can be identified by these numbers in the same way as identifying the location.

The nursing staff carries a device for using the memo system. In this study, we use an iPod as the device because of its lightweight and less interference to the nursing activities. The device identifies the recipient and the nursing location by scanning the BLE beacons attached to the residents and the location and shows the result on the screen. The nursing staff can input the information of the nursing activity by tapping the items on the device and submit them to a server. In the server, the time of nursing, the staff's name, the recipient's name, the nursing location and the detailed information related to the location are stored.

By scanning the signal of the BLE beacon to identify the nursing recipient and the location, switching the information input screen automatically, and showing specific contents on the screen of the device, the proposed system satisfies the 3 requirements mentioned in Section III-A.

C. Application

Fig.3 shows the image of the application installed in the devices carried by the nursing staff. Every time the staffs care an elderly, they launch the application and input details
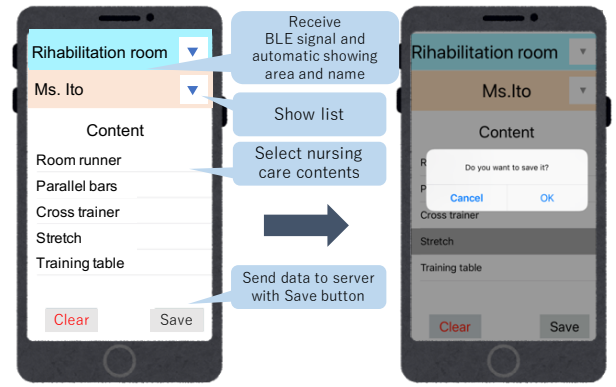
about the nursing such as the information of the meals and the situation of the feces of the recipient. The application supplies the information of the recipient and the nursing location automatically by scanning the signal of the BLE beacon.

Also, after the identification, the application shows the specific items on the screen and the staff can input information by choosing the items and submit it to the server. Items depending on the nursing home location are shown on the device, then staffs tap them to input contents, and save on the server.

Suppose a case where a nursing staff goes to the toilet together with the recipient of the nursing and the information of the staff, the BLE beacon, etc. have been registered in the application in advance. The flow of nursing with this memo system is shown below: 1) A staff and a resident go to the toilet; 2) The staff launches the application; 3) The device scans the signal of the BLE beacons attached to the resident and the nursing home to identify the recipient and the nursing location; 4) The device switches to the specific view related to the toilet and shows the information of the identification; 5) The staff taps the items related to the toilet (e.g. the situation of the feces) on the screen and input data; 6) The staff taps the save button and sends the data to the server; 7) The sever stores the record of time and contents received.

Through these series, staffs can record detailed contents about the nursing care. This system improves the efficiency of the generation of the daily care reports since the information about the care recipient and the nursing care location is automatically inputted by scanning BLE beacons and the detailed contents about the nursing care sent to the server are stored in the database for staffs to review them anytime.

IV. EXPERIMENT

Before conducting an experiment in actual nursing home, we evaluated the feasibility of our proposed application in the emulated environment.

A. Outline of Experiment

In this emulated environment, a place name, a recipient name, and recipient status are randomly displayed on the
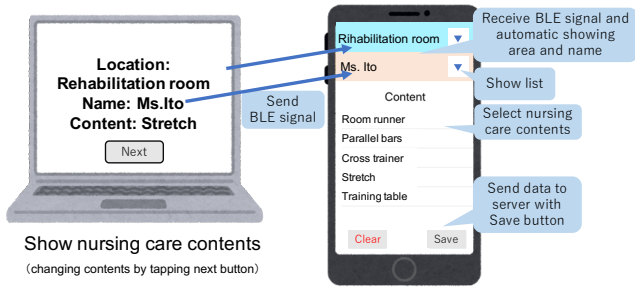
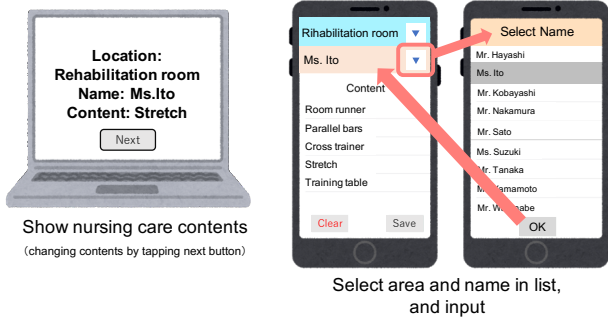Fig. 4. Experiment by proposed system.

Fig. 5. Experiment by conventional system.

Fig. 6. Experiment by handwritten method.

TABLE I
COMPARISON OF 3 RECORDING WAYS

	Proposed	Conventional	Handwriting
Average time for recording(s)	9.0	14.8	21.9
Accuracy(%)	97.7	99.5	99.9

screen of a laptop. Simultaneously, both beacon signals of recipient and place are broadcasted from the laptop. We asked participants to record the displayed information by three different ways: 1) the proposed system; 2) the conventional system, which does not have the automatic switching function; 3) the handwriting method. Then, we evaluated the time for inputting information, the accuracy of recording and the usability of the system.

Eight participants attended our experiments. We asked each participant to write nursing care records about the care place, care recipient, and nursing contents 30 times by three methods. After making records, we asked them to answer a questionnaire to evaluate the usability.

B. Emulated Environment

In the emulated environment, three kinds of information (the care place, the care recipient, and detailed nursing care contents) are randomly shown on the PC. Simultaneously, two BLE signals associated to the displayed information are transmitted from the same PC.

As a care place, seven locations such as toilet or rehabilitation room are registered in advance. It is based on the actual nursing home environment we are collaborating with. As the care recipients, 20 persons are registered. It is also based on the actual environment. Because under Japanese law, the maximum number of registrants per facility is limited to 29 persons, and the maximum number of acceptances per day is limited to 18 persons, the number of 20 persons is reasonable.
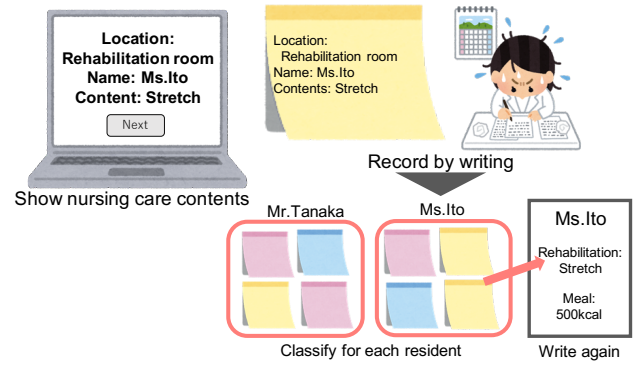
The nursing care content depends on the location. For example, "rehabilitation, Mr.Yamada, Parallel bars," or "Bath, Ms.Kato, Whole body bath" are shown as contents. The time until switching to the next contents is as the input time for one input.

We conducted evaluation experiments by the three methods: 1) the proposed system; 2) the conventional system; 3) the handwriting method. We show the outline of each method in Fig. 4-6. In the experiment of the proposed and the conventional systems, participants use a mobile application we developed. Although the user interface of both applications is the same, embedded functions are different. In the experiment by handwriting method, participants take notes about the care location, the resident's name, and the detailed content by hand. After taking notes 30 times, we choose one resident name, and asked participants to collect information about the resident and summarize to reports.

We asked participants to answer a questionnaire after entering records by each method. The questionnaire consists of questions to answer in five levels for ease of use and we asked participants about the usability of the system such as ease of recording and the clarity of the system.

C. Results

We evaluate our system from the following three points; (1) the time for making care reports, (2) accuracy of reports created, (3) the labor and annoyance in making reports.

We show the time and accuracy for inputting contents in Table I, and the box plot about the time of recording reports in Fig. 7.

When comparing the average time of inputting, the time in the proposed system was 9.0 seconds which was the shortest. Moreover, participants could input contents most quickly by the proposed system. The time of inputting by the conventional
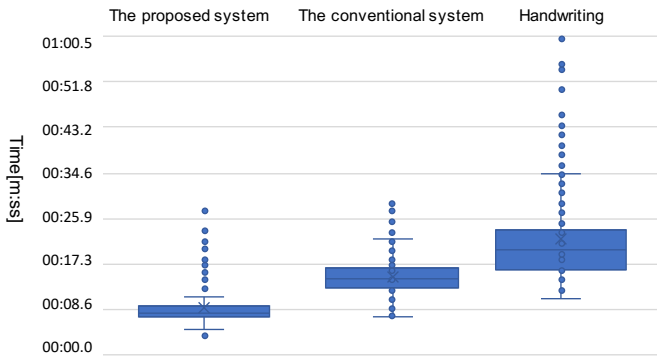
Fig. 7. Time of making records.

Fig. 8. Result of questionnaire about labor and annoyance of recording.

Fig. 9. Result of questionnaire about proposed system.

system and handwriting were 5.8 seconds and 12.9 seconds more than the proposed system respectively. The interquartile range of the input time by the conventional system was 14.7, while the range by the proposed system was 6.2. Regardless of contents, the input time was almost the same. Participants could fill contents within 30 seconds by the proposed or conventional system. However, in the case of handwriting method, it took over 30 seconds.

Also, in the handwriting method, participants spent long time for classifying and rewriting. When summarizing notes to reports, participants must find the records of the specific care recipient and copy them, which was useless. The average time of classifying and summarizing one content was 18.3 seconds. When staffs do such things for all residents, it will take longer time.

Regarding the correct answer rate, the results of all methods were almost perfect. However, comparing these results among the methods, handwriting input showed the highest correct answer rate and the proposed system showed the lowest. In the proposed system, participants could submit a record even if they did not select all the three required fields. Therefore, they submitted a record before the resident's name was shown on the application or the system cannot identify the resident's name correctly. In the experiment, if the device cannot receive BLE signals and automatically switch contents in the input of the proposed system, we asked participants to choose and record the correct contents from the list. However, the case recorded by this way is only 0.7% of all recordings. Therefore, the system can correctly receive BLE signals.

The result of questionnaire about annoyance of inputting is shown in Fig. 8, and the result of questionnaire about the proposed system is shown in Fig. 9. In Fig. 8, we compared the questionnaire results on the labor and annoyance of recording. We asked participants to evaluate the annoyance of input in five levels: Very easy, Easy, Neither, Troublesome, and Very troublesome. No one answered that inputting by the proposed system was troublesome. But more than 80% of them said that input by the conventional system was troublesome, and all participants answered that handwriting was troublesome. Also,
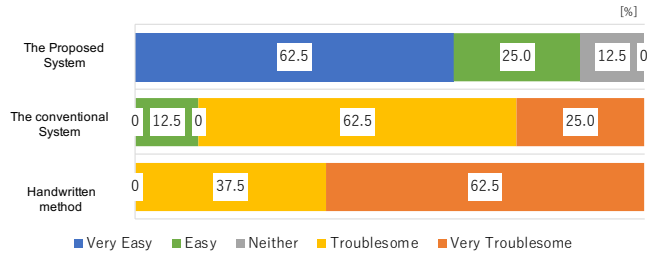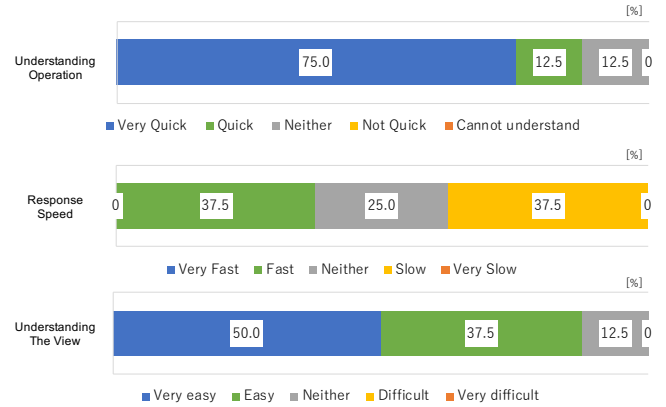
from Fig. 9, about usage of the system, we found that more than 80% of participants could understand the operation of the proposed and conventional systems very quickly or quickly. About the response speed of these system, there were both those who reported it was slow and those who reported it was fast. There was not much difference between the proposed system and the conventional system.

We found that the time for creating records can be shortened by using the proposed system. Specifically, compared with handwriting method which is the current way in our collaborated nursing home, the required time for inputting one data was reduced to half by using the proposed system.

In the conventional system, participants must select the care location, the care recipient and detailed care contents from the list. On the contrary, first two items are automatically filled in our proposed system. It contributes to reduce the required time for recording.

If there are many locations and residents, participants will need to select a specific item from even more choices in the conventional system. In the handwriting method, it took much more time to classify and summarize memos, with the increase of locations or residents. On the contrary, our proposed system is not affected by the increase of choices because it automatically identifies the locations and residents. By using the proposed system, participants do not need to classify or summarize the distributed paper memos. Hence, the time of making care reports was drastically shortened.

Since the task in this experiment is simple, like selecting

the item from the list, the effect of our proposed system is relatively large. However, we still need to evaluate complicated tasks like writing detailed long sentences or measuring the maximum and minimum level of blood pressure in the future.

The accuracy of inputting records was very high with all methods. Specifically, participants made few mistake by handwriting method, because they checked the items every time and they wrote content slowly one by one over time. The most frequent entry mistake in the proposed system was submitting empty records. Therefore, we need to improve the application so that participants cannot send data unless all contents are filled.

Moreover, the result of questionnaire revealed that participants did not feel annoyed in inputting data and they can input easily by using the proposed system. The reason of reducing the annoyance is that the number of tap operation while entering record is lesser than the conventional system. Also, we found that participants were able to understand how to use the proposed system quickly.

In this experiment, participants more required to tap three times in the proposed system, and nine times in the conventional system, at least until input is completed. In the conventional system, OK button for confirming the selected items always appeared after selecting the location and the resident. Some participants felt bothered by this confirmation. To input the correct data, the confirmation is important but too many check operation annoyed participants.

In handwriting method, some participants said that writing was not only troublesome, but also tiring their hands. We determined that in writing, it took long time to make records and the work was also physically hard. The response speed of systems was the same between the proposed and conventional systems, but some participants reported that the proposed system was also slow because it took several seconds to identify BLE signals and show items on the device.

In the proposed system, the system receives BLE signals, switches the view depending on the participant's location, and shows information about nursing care. By using our system, participants can easily input detailed care contents by simply tapping on the view. Therefore, our proposed system fulfills the requirements mentioned in Section III-A.

V. CONCLUSION

In this paper, aiming to reduce work load of care staffs to make care reports, we proposed the mobile care recording application which automatically identifies the location and the care recipient, and switches the input view and items depending on the location.

Then, we evaluated the time of inputting, usability, and accuracy compared with the conventional system which does not include automatic switching view function and handwritten method. As a result, the input time was shortened by about five seconds by using our system compared with the conventional system. Furthermore, we carried out questionnaire about the usability of the system and found that participants did not feel any annoyance during inputting care information, and could correctly make reports. By using our system, participants could make reports easily and instantly.

As future work, we plan to conduct experiments in the actual nursing home and evaluate and improve the system. Additionally, we will discuss using this application in other fields, such as factories, convenience stores, and so on.

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